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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/633,598	08/07/2000	John M. Redwing	410	2700

7590 07/30/2003

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EXAMINER	
LOUIE, WAI SING	

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 07/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/633,598	REDWING ET AL.	
	Examiner	Art Unit	
	Wai-Sing Louie	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 May 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9 and 35-42* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 35-42* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other .

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-8, and 35-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hiroharu (JP 09-307097) in view of Streit et al. (US 5,668,387).

With regard to claims 1, Hiroharu discloses a gallium nitride-based high electron mobility transistor, HEMT ([0001] to [0057] and fig. 8), comprising:

- A channel layer 20 formed of an InGaN alloy ([0051] and fig. 8), but do not disclose the active layer is at least partially relaxed. However, Streit et al. disclose a pseudomorphic high electron mobility transistor (HEMT) having a partially relaxed channel layer 22. Streit et al. teach a pseudomorphic HEMT could have a thicker channel layer to excess the allowed critical thickness (CT) and lead to higher electron concentration in the channel layer (Streit col. 1, line 41 to col. 2, line 20). Therefore, it would have been obvious to one with ordinary skill in the art to provide a relaxed channel layer in order to increase the electron flow through the channel layer to have a high efficiency HEMT device;
- An additional layer 20 over the channel layer 21 made of $Al_xGa_{1-x}N$, where x is 0.2 ([0043] and fig. 8).

With regard to claim 2, Hiroharu discloses an additional layer 20 comprises AlGaN material, forming an AlGaN/InGaN heterostructure with the channel layer 21 ([0051]).

With regard to claim 3, Hiroharu discloses the semiconductor device comprising a GaN layer 12, underneath the InGaN layer 21 (fig. 8).

With regard to claim 4, Hiroharu discloses the HEMT device does not comprise an aluminum-containing layer ([0004] and fig. 10).

With regard to claims 5-6, Hiroharu discloses the device comprising an additional layer 12 made of GaN material, forming a GaN/InGaN HEMT with the channel layer 21 (fig. 8), but do not disclose an InGaN/InGaN HEMT. However, it is common in the art to form a GaN/InGaN or an InGaN/InGaN HEMT. Hiroharu teaches, in general, the GaN layer could be represented by an AlGaN, an InGaN, an AlGaInN, a BGaInN, etc ([0011]). Therefore, it would have been obvious the spacer layer 20 could be InGaN to form an InGaN/InGaN HEMT in Hiroharu's device.

With regard to claim 7, Hiroharu discloses the HEMT comprising an AlGaN layer 19 and the AlGaN layer is doped (fig. 8).

With regard to claim 8, Hiroharu discloses the HEMT comprising an AlGaN layer 20 and the AlGaN layer is undoped (fig. 8).

With regard to claim 35, Hiroharu discloses the AlGaN material is $Al_xGa_{1-x}N$, where x is 0.20 ([0043]), but do not disclose x is about 0.1. Since the applicant has not established the criticality of the mole fraction stated and since these the mole fractions are in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use these value in the mole fractions of the device. Where patentability is said to be based upon

particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. *In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).*

With regard to claim 36-38, Hiroharu discloses does not disclose the thickness of the InGaN channel layer 21 is from about 100 to about 5000 nm. Since the applicant has not established the criticality of the thickness stated and since these the thickness are in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use these value in the thickness of the device. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. *In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).*

Claims 39-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hiroharu (JP 09-307097) modified by Streit et al. (US 5,668,387) as applied to claim 1 above, and further in view of Schetzina (US 5,670,798).

With regard to claim 39, Hiroharu discloses the device comprising:

- A substrate 11 (fig. 10);
- A GaN buffer layer 12 on the substrate 11 (fig. 10);
- The channel layer 21 on the GaN buffer layer 12 ([0051]);
- An AlGaN spacer layer 20 on the channel layer 21 ([0043]);
- Hiroharu discloses an undoped AlGaN donor layer 19, but does not disclose the doped AlGaN layer 19 is formed on the AlGaN spacer layer. However, having an

AlGaN spacer layer on top of the channel layer is well known in the art. Schetzina teaches the AlGaN spacer would improve the carrier confinement (Schetzina col. 21, line 36 and fig. 29b). Therefore, it would have been obvious to have an undoped AlGaN spacer layer on top of the channel layer in order to improve the carrier confinement.

With regard to claims 40-41, in addition to the limitations disclosed in claim 39, Hiroharu also discloses:

- Hiroharu discloses the spacer layer 20 is AlGaN, but does not disclose the spacer layer 20 is GaN. However, Hiroharu discloses, generally, the GaN layer could be represented by an AlGaN, an InGaN, an AlGaInN, a BGaInN, etc ([0011]). Therefore, it would have been obvious the spacer layer 20 could be GaN or InGaN.

With regard to claim 42, Hiroharu discloses a two dimensional electron gas between the InGaN channel layer 21 and the AlGaN spacer layer 19 (fig. 8-9).

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiroharu (JP 09-307097) modified by Streit et al. (US 5,668,387) as applied to claim 1 above, and further in view of Pao et al. (US 5,270,798).

With regard to claim 9, Hiroharu discloses a two dimensional electron gas channel undoped InGaN channel 21 (fig. 9), but does not disclose a sheet charge layer to increase sheet density in relation to a corresponding undoped AlGaN layer 20. However, Pao et al. disclose a sheet charge layer 20, adjacent to spacer 18, provide sheet charge for 2-dimensional channel 16

(Pao col. 3, lines 49-67). Pao et al. teach the sheet charge layer spreads out a high electric field domain influencing the 2-dimensional channel and reduces the maximum voltage gradient (Pao col. 4, lines 52-62). Therefore, it would have been obvious to one with ordinary skill in the art to modify Hiroharu's device with the teaching of Pao et al. to provide a sheet charge layer in order to create a high electric field domain and to reduce the maximum voltage gradient of the device.

Response to Arguments

Applicant's arguments filed 5/20/03 have been fully considered but they are not persuasive.

- Applicant argues that Hiroharu has a high aluminum content of 0.2 in the n-AlGaN layer 19 and the undoped AlGaN layer 20 while the present invention has a low aluminum content of less than 0.2 (claim 1) and preferably 0.1 (claim 35). However, the mole fraction of aluminum in the AlGaN layer is merely a process optimization. Since the applicant has not established the criticality of the mole fraction stated and since these the mole fractions are in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use these value in the mole fractions of the device. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. *In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).*

- Applicant argues that the InGaN/GaN or the InGaN/InGaN HEMT is different from the InGaN/GaN or the InGaN/InGaN MQW disclosed in Schetzina. However, Hiroharu discloses an InGaN/GaN HEMT and Hiroharu also discloses, generally, the GaN layer could be represented by an AlGaN, an InGaN, an AlGaInN, a BGaInN, etc ([0011]). Therefore, it would have been obvious the channel Hiroharu's device would be InGaN/InGaN HEMT.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

LONG PHAM
PRIMARY EXAMINER

wsl
July 22, 2003